Description

METHOD FOR MANUFACTURING PRINTED WIRING BOARD

TECHNICAL FIELD

[0001] The present invention relates to a method for manufacturing a flat printed wiring board in which spaces between circuit patterns are filled with a resin.

BACKGROUND ART

[0002] In the case of manufacturing a multilayer printed wiring board by e.g. a build-up method, it is necessary to flatten the surface of a lower layer substrate in order to increase the wiring density. However, the circuit patterns of a printed wiring board may be manufactured by a subtractive method for removing unnecessary parts of copper foil via etching. As a result, the printed wiring boards are generally formed into an uneven configuration. The part representing the circuit pattern typically rises above the surrounding surface of the base material.

[0003] Therefore, in order to flatten a printed board in which the surface is formed in an uneven form as described above, a following method has been proposed. For example, a method comprising: laminating a semi-cured resin sheet onto circuit patterns; pressing the resin sheet in a reduced pressure atmosphere so as to have the resin fill in the spaces between the circuit patterns, and curing

the resin; and polishing the cured resin covering the circuit patterns, in order to obtain a smoothed substrate with exposed circuit patterns.

[0004] Heretofore, a laminating press has generally been utilized for manufacturing a multilayer substrate by pressing a laminated body. The laminated body is formed by laminating a prepreg and a metallic foil, etc., onto an uneven core substrate on which circuit patterns are formed. In the laminating press, which is intended for making a multilayered substrate (i.e. for laminating an insulation layer onto the circuit patterns), there has been a condition in which the pressing must be performed while adjusting the pressing pressure and the pressing amount (i.e., distance), etc., in order to make the insulating layer on the circuit patterns have a predetermined thickness. In the above described circumstances, the pressing condition may be so demanding that it is difficult to collectively press a plurality of sets of laminated bodies. More specifically, in the case where a plurality of sets of laminated bodies are arranged to be collectively pressed in order to form a number of individual laminated bodies with a predetermined thickness, various conditions such as the pressing pressure and the heat transfer rate in each laminated body need to be made uniform across the whole group of laminated bodies. To this end, smoothing plates must be arranged between respective laminated bodies. Accordingly, a configuration for performing collective pressing via the arranging of smoothing plates between respective laminated bodies has been generally adopted in the art of laminated pressing.

[0005] However, the above described method of performing collective pressing by arranging smoothing plates between respective laminated bodies has a problem in that the number of laminated bodies that can be received by a pressing machine with a fixed width is reduced by the thickness of the plurality of smoothing plates. As a result, the productivity level of the laminating press is lowered.

[0006] The present invention has been made in view of the above described circumstances. An object of the present invention is to provide a method for manufacturing a flat printed wiring board and with a relatively excellent level of productivity.

DISCLOSURE OF THE INVENTION

[0007] In order to solve the above described problem, according to the present invention there is provided a method for manufacturing a flat printed wiring board in which the spaces between circuit patterns are filled with a resin. The method comprises: laminating a plurality of sets of laminated bodies, in which the sets of laminated bodies are formed by superposing a semi-cured resin sheet onto a printed wiring board with circuit patterns formed thereon, via a mold release film; placing the laminated plural sets of laminated bodies so as to be interposed between a pair of smoothing plates and then pressing the laminated plural sets of laminated bodies in a reduced pressure atmosphere in order to cure the resin; and then polishing the cured resin covering the circuit patterns, thereby exposing the circuit patterns.

[0008] The circuit patterns may be formed on both sides of the printed wiring board. A metallic foil with a roughened surface facing the resin layer may also be superposed on the resin layer. In this case, the metallic foil may be formed from a different type of metal than the type of metal of the circuit pattern.

[0009] The object of the present invention is not to make a multilayered substrate by forming an insulating layer on circuit patterns as in the conventional case, but to provide a flat substrate with exposed circuit patterns by filling the spaces between the circuit patterns with resin. Accordingly, the adjustment of the thickness of the resin layer on the circuit patterns is not required. The resin only needs to be pressed to the very limit of the height of the circuit patterns so as to leave as little resin as possible on the circuit patterns and to fill the resin into the spaces between the circuit patterns. As a result, a pair of smoothing plates only needs to be arranged on the outermost parts of the plurality of sets of laminated bodies. In this way, by reducing the number of smoothing plates at the time of pressing it is possible to increase the number of laminated bodies received in a pressing machine having a predetermined width. It is also possible to improve the thermal circulation at the time of heating. Consequently, the productivity can be greatly improved. Further, a similar operating effect can also be obtained even when the above described circuit patterns are formed on both sides of a substrate.

[0010] Additionally, a metallic foil with a roughened surface facing the resin may be interposed between the smoothing plate and the resin prior to the time of pressing the smoothing plate against the resin on the substrate. This allows the resin to more easily spread thinly and also causes the surface of the resin to be formed in a fine uneven state corresponding to the roughened surface of the metallic foil. As a result, the residual resin layer can be more easily polished.

[0011] Still further, in the case where the metallic foil interposed between the smoothing plate and the resin is formed with a different kind of metal from the kind of metal used in the circuit patterns, the metal foil may be removed by selective etching. The selective etching may be used to only dissolve the metallic foil without affecting the metal of the circuit patterns.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure 1 is a sectional view of a copper clad laminated board;

Figure 2 is a sectional view of the wiring board with circuit patterns formed thereon;

Figure 3 is a sectional view of a wiring board on which resin layers are formed with resin sheets according to an embodiment of the present invention;

Figure 4 is a schematic view of a layout at the time of vacuum pressing;

Figure 5 is a sectional view of the wiring board after the resin is cured;

Figure 6 is a sectional view of the wiring board after the metallic foils are removed; and

Figure 7 is a sectional view of the wiring board after polishing.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] In the present embodiment, as shown in Figure 1, a copper clad laminated board 10 is used as a base material in which copper foils 12 are adhered to both sides of a glass epoxy substrate 11 with a thickness of 100 μm to 3000 μm. Circuit patterns 15 are formed on the copper clad laminated board 10 by a known photoetching method (see Figure 2).

[0014] Next, as shown in Figure 3, resin layers 16 are formed on the substrate by laminating resin sheets 20 with a thickness of about 30 μm, which are formed by e.g. semi-cured thermosetting epoxy resin, onto the circuit patterns 15 of the wiring board. On the resin sheets 20, nickel foils 17, having a thickness of 18 μm and one face of which is roughened by a needle shaped plating, are also laminated beforehand such that the roughened surface faces the resin sheet 20. At this time, minute air bubbles may also be contained in the resin layer 16. Additionally, the surface of the resin layers 16 is in a gradually rising/falling (i.e., undulating) state as the surface of the resin layers 16 pass over the raised part of the circuit patterns 15. Thirteen sets of laminated bodies 30 as described above are prepared and superposed via the intermediary of Tedlar 31 as a mold release film.

[0015] Next, as shown in Figure 4, a pair of mirror surface plates 32 with a thickness of about 1 mm are arranged via Tedlars 31 at the outermost parts of the thirteen sets of laminated bodies 30. On the mirror surface plates 32, kraft papers 33 (e.g., with a thickness of 0.25 mm × 5 sheets) as a cushioning material, stainless jig plates 34 (e.g., with a thickness of 4 or 5 mm) and top boards 35 (e.g., with a thickness of 4 mm) as heat insulating materials, are respectively laminated in this sequence. The entire assembly of materials is placed on a carrier plate 36 so as to be covered by a cap 37. After having been thusly arranged, the assembly of materials including the carrier plate 36 and the cap 37 are then placed at a predetermined position in a pressing machine in order to be pressed at a pressure of approximately 30 kg/cm^2 in a reduced pressure atmosphere. As a result, the surface of the resin layers 16, which is in a gradually rising/falling state, is compressed. The resin on the circuit patterns 15 is moved so as to fill the spaces between the circuit patterns. As a result, the substrate as a whole is flattened. The air bubbles in the resin layers 16 rise up to the vicinity of the surface of the resin layers 16 so as to be removed from inside of the resin.

[0016] After the resin layers 16 on the circuit patterns 15 are sufficiently compressed and the air bubbles in the resin are fully released to the outside, the resin layers 16 are heated so as to be finally cured.

[0017] When the resin is completely cured, the carrier plate 36 is carried out from the pressing machine and the laminated bodies 30 are removed. The nickel foils 17 adhered to the surfaces of the resin layers 16 of each laminated body 30 are then removed by an etching solution used exclusively for nickel (see Figures 5 and 6). As a result, the thickness of the resin layers remaining on the copper circuit patterns 15 becomes 10 μm or less and the surface of the resin is in a roughened state. In order to flatten the substrate, primary smooth surface polishing is performed by ceramic buff polishing to remove the resin layers 16 from the circuit patterns 15. Secondary finish polishing is then performed by a surface grinding machine in order to bring the average roughness accuracy of the surface to become equal to or less than 3 μm (see Figure 7). In the case of surface polishing, since the resin layers 16 remaining on the circuit patterns 15 have an extremely thin thickness (e.g., such as 10 μm) and the surface of the resin layers is roughened, the surface polishing is easily performed.

[0018] In this way, according to the present embodiment, a flat printed wiring board with exposed circuit patterns can be manufactured with good level of productivity.

[0019] The present invention is not to be limited to the embodiments described above with reference to the drawings. For example, the following embodiments are also considered as included within the scope of the present invention. In addition, further variations other than

the following embodiments are possible within the scope and spirit of the invention.

[0020] (1) In the above described embodiment, the circuit patterns are formed by the subtractive method. However, the circuit patterns may also be formed by an additive method.

[0021] (2) In the above described embodiment, a thermosetting epoxy resin is used as the material of the resin layers, but the embodiment is not limited to this material. A thermosetting resin, such as a urea resin, a melamine resin, a phenol resin, an acrylic resin, and an unsaturated polyester resin may also be used.

[0022] (3) In the above described embodiment, nickel is used as the metallic foil material, but the embodiment is not limited to this material. Other metals such as copper may also be used.

INDUSTRIAL APPLICABILITY

[0023] As described above, according to the present invention a flat printed wiring board with exposed circuit patterns can be manufactured with a good level of productivity.